NRC NEWS

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"New Direction in Research"

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Commissioner
U.S. Nuclear Regulatory Commission

Nuclear Safety Research Conference

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Welcoming remarks

Good morning everyone!

I would like to welcome you to the Nuclear Safety Research Conference, or what was formerly known as the Water Reactor Safety Meeting. I see some familiar faces in the audience. To them, and to all of you who have been to previous Water Reactor Meetings before, welcome back. To those who are at this meeting for the first time, I hope you would find this meeting insightful, and informative. We expect to benefit from the new ideas and new information, which you bring along with you.

Finally, I want to extend a warm welcome to our foreign guests who have come from far. Most issues critical to the industry today, whether it is a need to improve the security of our facilities, extend the life of our plants, or develop advanced reactors which are safe as well as cost-competitive, are multinational rather than national issues. Therefore, your presence and participation in this meeting are a benefit to all of us.

In addition to the meeting, I hope you would enjoy the fine October weather in Washington, D.C. I also hope you had, or will have time to enjoy the many national monuments and museums in the city, before you return. All of them are only a short train ride from this hotel.

We all recognize from history that issues which confront the nuclear industry are not static. The issues that were critical have been changed, and will continue to change. The directions of research, must change to accommodate the changing needs. History also shows that the Office of Research and the NRC have successfully changed direction to address the issues which were contemporary to the time. Many of us may not have been part of the nuclear community when issues were confronted relating to emergency core cooling, in the 1970s. The Office of Research's focus on code development and experiments helped NRC address these issues and enhance the regulatory process. In the 1980s, continuation of research activities on probabilistic risk assessment lead to publication of NUREG-1150, issuance of Generic Letter 88-20, and the development of many tools and methods to enhance the regulatory process through the use of probabilistic risk assessment. During the 1990s, NRC did a fair amount of research on ageing of equipment in our plants, thermal hydraulic analysis in advanced reactors, and even more research in the area of probabilistic risk assessment. This research is helping us address key questions relating to plant license renewals, an improved reactor oversight process, and risk-informing our regulations.

Before your minds wonder off to the exciting topics which will be discussed this afternoon, I want to describe what I will be speaking about today. First, I will address some of the initiatives we have undertaken to improve the effectiveness of NRC. Second, I will discuss present challenges to industry. Finally, I will discuss some of the new directions which NRC may be heading toward, specifically in the area of international standards on radiation protection. In that respect, I will share with you recent advancements in this area and my vision of how these advancements should, or should not, affect U.S. regulations.

Initiatives, to improve Effectiveness of NRC

Over the last several years, the agency, in part using significant contributions from the Office of Research, has made major strides to be more effective. We have done this by changing the regulatory framework to allow the NRC to shift resources to address issues which have the highest impact on public health and safety. The new reactor oversight process is an excellent example of this changing framework. Even though we are still experiencing some growing pains, NRC has created a process that assesses the risk significance of events or issues, and NRC uses this risk significance to guide us in our interactions with licensees.

In the area of changes to regulations, the Commission has been looking at staff's proposals to risk-inform 10 CFR 50.44 which reduces requirements on hydrogen recombiners. The Commission is also looking at Staff's proposals to risk-inform 10 CFR 50.46 which will reduce unnecessary burdens on the licensees in their loss-of-coolant analysis (LOCA). The progress we have made to improve effectiveness may not be as fast as NRC like it to be. However, NRC has made these fundamental changes with public safety as our number one priority, and sometimes that involves taking extra time. We look for ways to improve effectiveness, and I commend the staff on their accomplishments, and thank the industry for continuing active, constructive dialogues.

Present challenges

Even though a good safety level for nuclear facilities and applications has been achieved in most countries, there are areas where improved knowledge will be necessary to efficiently and effectively regulate and operate the current fleet of reactors as they age, and to provide the scientific and technical basis for the development of innovative nuclear reactors and novel means for high-level waste management and disposal. History indicates that new issues will continue to emerge from operational experience, and an enterprising and dynamic industry together with an efficient and effective regulator will continue to propose innovative initiatives to improve or maintain safety in a cost-effective manner. Further, new designs are being proposed which have many characteristics that differ from those of the current fleet of plants. Availability of knowledgeable and well-trained human resources is necessary to sustain and improve the safety of nuclear power and provide effective regulation of it through all its phases from research and conceptual design, through operation, to and finally to waste management and decommissioning.

Some examples of areas where novel emerging issues have been identified follow. For each example, emphasis must be placed on understanding the uncertainties involved and highlighting those needing attention; as well as the role of risk information in identifying safety and regulatory needs.

Economic conditions are leading to extension of the operating cycle, higher fuel burnup and increased power levels. As in this country, initiatives have been identified in several other IAEA member countries to explore use of mixed oxide fuel either because of non proliferation considerations or to recycle fuel to use it more efficiently. These are being evaluated by the regulatory authorities in member states. The combined effect of these considerations must be evaluated to determine the overall safety impact.

Economic deregulation has had many influences on plant performance. It could create the potential to lead to degradation of existing safety principles, if the impacts of deregulation on plant performance, are not fully understood and monitored by the plant operator and an independent regulator to provide early warning of changes in culture and operations. Similarly, extending the effective operating life of nuclear power plants will bring great benefits, but requires effective programs for mitigating or managing the deleterious effects of plant ageing.

Life extension, decommissioning, introduction of new technology, and aging workforce pose unique challenges in the area of human performance. We must be prepared to understand these challenges and develop means to measure, monitor and trend organizational and management performances with regard to safety as well as individual human performance.

New reactor concepts (e.g., Pebble Bed Modular Reactor, and advanced LWRs) are under development that appear to have advantages in both economics and safety over existing plants. Where there is a reasonable prospect that such new designs may be proposed to a country's regulatory authority, it is essential that the regulatory authority prepare in advance for such a proposal, ensuring it has the proper mix of technical skills and experimental facilities to thoroughly evaluate the safety of such new designs.

Similarly, in the fuel cycle, new concepts are under consideration for both the enrichment of new fuel and the disposal of radioactive waste. Because of these initiatives, research expertise is needed. The application of risk analysis techniques to nuclear materials manufacturing or processing facilities is well

underway, but these facilities differ from reactors and it may be necessary to adopt a different technique for risk assessments.

The analysis of the risk associated with both interim aboveground storage of spent fuel and the transportation of high level waste to final repositories requires detailed analyses of cask designs and evaluation of material behavior. Similarly, the long-term storage of radioactive waste will require monitoring as operational information begins to be assembled. Experience from reactors and other industries using advanced technology indicates operational observations may require mid-course corrections by the regulatory body as well as by the operator of the facility to maintain safety.

New enrichment and recycle approaches as well as consideration of transmutation of high level waste will require careful evaluation of the need for safety research in parallel with developmental analyses.

The complexity of these techniques, and the safety, non proliferation, and operational concerns will require a cadre of nuclear safety experts to evaluate future research needs. We must be prepared to understand these challenges and develop means to measure, monitor and trend organizational and management performances with regard to safety as well as individual human performance. Adequate research must be conducted to understand these new technologies, their associated risks to public health and safety, the uncertainty in the risk estimates, and to evaluate where controls are needed for public protection or where further research is needed to reduce uncertainties.

Let me turn now to the core topic. The essence of what NRC does pertains, of course, to protecting public health and safety and the environment. In accomplishing this mission we rely on many processes, procedures, and regulations. During the remaining part of my speech, I would like to contribute to this meeting by talking about (a) the evolution of new recommendations which may be developed by International Committee on Radiation Protection, and (b) my perspectives on how these recommendations should or should not affect the near-term and long-term policies of the NRC.

As you all know, technology evolves with the advancement of science and science advances through research and study. These advancements occur at academic institutions, laboratories, and other research and development facilities through the efforts of many dedicated members, like you, in the scientific community. Regulatory agencies are faced with the challenge of how to translate our current knowledge of radiation health effects into a regulatory framework, via regulations and with regulatory guides, that are protective of not only the workers, the public, and the environment, but, at the same time, strike a balance between the uncertainties in that knowledge and the beneficial applications of radiation. For example, we certainly are all aware of uncertainties which have lead to controversy over whether the present uses of the linear non threshold model to describe radiation health effects at low doses and dose rates are appropriate for establishing regulatory standards in radiological protection.

Many factors influence decisions in the business of setting regulatory standards for radiation protection. Historically, NRC's regulatory approach for radiation protection has considered new scientific information on radiation health effects as one important input into this complex business. The NRC has also depended upon a process in which first, independent bodies of experts evaluate information on radiation health effects and then other bodies of experts, drawing upon this collective knowledge, develop recommendations for systems of

radiation protection. Examples of the first set of bodies are the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), the Radiation Effects Research Foundation (RERF) and the U.S. National Academy of Sciences Committee on Biological Effects of Ionizing Radiation (BEIR). The second set includes The National Council on Radiation Protection and Measurements (NCRP), in this country, and the International Council on Radiation Protection (ICRP). After considering recommendations from these scientific bodies, if the Commission agrees that revisions to NRC's radiation protection regulatory framework are needed, then the changes are proposed through an open and inclusive process that provides for public input. Finally, NRC is subject to statutory requirements to follow the generally applicable radiation protection standards issued by the U.S. Environmental Protection Agency.

This then moves us from science into policy decisions. In the final analysis, the flexibility and direction that agencies have in making these policy decisions are dictated by a number of considerations including the underlying legislation for regulatory agencies and, in some cases, by court decisions on the implementation of the legislation.

For those who are not familiar with the activities of the ICRP, and how ICRP influences NRC Regulations, let me say a few words about some key activities of ICRP and how they relate to NRC's regulations.

ICRP updates models to reflect new biokinetic information and to achieve greater predictive accuracy through the application of physiologically realistic model structures like the respiratory tract model described in ICRP Publication 66 (1994). Furthermore, using these models, ICRP provides recommendations to the international radiation protection community. The ICRP models and recommendations provide significant input in formulating the regulations which NRC adopts, after incorporating stakeholder concerns. For example, the current 10 CFR Part 20 which establishes standards for protection against radiation adopted models and recommendations from ICRP Publication 26 published in 1977 and Publication 30 published in 1978.

Since the 1970s ICRP has made major changes to ICRP recommendations and models-- and --- they are continuing to evaluate many more changes.

Let me first discuss proposed changes to the ICRP models and how we might begin using them. During the last few years the ICRP has updated many of the models in ICRP Publication 30 which were published in 1978, to reflect new biokinetic information and to achieve greater predictive accuracy. Because the models of Publication 30 often reflected overly cautious parameter values chosen in the absence of physiological constraints, it is common for the newer models to yield lower dose coefficients. For example, the updated effective dose coefficient for the inhalation of ^{232}Th by a worker is about a factor of 15 lower than the earlier value. However, for a few radioisotopes, the new models have led to substantial increases in dose estimates. Some licensees have made requests to use these new models, and on a case-by-case basis, since these models clearly reflect advances in knowledge, we have granted a few exemptions to the rules.

Unlike models which are purely scientific correlations based on experimental or other information, ICRP recommendations must be evaluated in light of other factors such as cost-benefits, perceptions, and political ramifications. Since 1978, the ICRP has made major revisions to its basic radiation protection recommendations. These were published in ICRP Publication 60 in 1990. This publication has

recommendations which supercede those of the ICRP Publication 26. Because of timing and other considerations, NRC adopted only some of the ICRP recommendations into Part 20. As an example, NRC adopted the ICRP-60 recommendation to lower the dose limit for the general public from 5 mSv (500 mrem) per year to 1 mSv (100 mrem) per year. However, with respect to the occupational exposures, even though ICRP-60 recommended a new occupational dose limit of 100 mSv (10 rems) in 5 years with a 50 mSv (5 rem) maximum, NRC believed that a reduction in the annual dose limit was not required since the annual average radiation dose to most occupational workers in 1987 was already well below 20 mSv (2 rem). Furthermore, as a part of the revised regulations, NRC included the concept of maintaining radiation exposures as low as reasonably achievable (ALARA).

It is my view that some facts and figures based on recent information must be fully evaluated before considering a rulemaking change to reduce occupational exposure as recommended by ICRP-60. For example, in 1999, out of approximately 150,000 monitored individuals at commercial power reactors, only twenty-four individuals received doses exceeding 20 mSv (2 rems), and only 2 individuals received more than 30 mSv (3 rems). No individual exceeded 50 mSv (5 rems). When you consider the fact that even ICRP-60 allows a maximum of 50 mSv (5 rem) per year, as long as the average over five years is below 20 mSv (2 rems), even if NRC adopts ICRP-60, there would not be any savings of dose. Furthermore, there would be substantial cost for implementing the new regulation, with uncertain or any added benefit.

For example, the cost of record keeping and managing radiation protection programs, may increase considerably due to loss of operating margin. Most plants operate with administrative controls which are lower than 10 CFR Part 20. If we lower the Part 20 annual dose limits, the administrative margin may have to be lowered further to ensure compliance. That may mean more situations of individual doses come close to administrative limits, more bookkeeping may be necessary, and more management involvement may be required with questionable additional benefits.

ICRP met in early September of this year to discuss additional changes. One area which has been discussed by ICRP is the value selected for limitation of a dose to a member of the public. Current NRC regulations in 10 CFR Part 20 specify 1 mSv (100 mrem) for this annual dose limit. This was derived from ICRP-60. Internationally there may be an interest to drop the public limit per se, and rely solely on a source related constraint of approximately 0.3 mSv (30 mrem) as the point of specifying whether a source (licensee) is appropriately controlling their material. This could potentially be a factor of three reduction in the dose limit from an individual facility, if ICRP were to adopt this recommendation.

The 1 mSv (100 mrem) to 0.3 mSv (30 mrem) reduction could have significant ramifications with respect to public perception, even though actual doses encountered by public would unlikely be affected. The pressure on modeling and in verifying compliance would increase because the industry would have to demonstrate compliance with lower margins. As far as ramifications on public perceptions, comparison of a 0.3 mSv (30 mrem) rather than a 1 mSv (100 mrem) limit against thresholds in other regulations, such as thresholds allowed for routine emissions, could lead to the belief that NRC is allowing too much radiation exposure to public via routine emissions.

ICRP is considering even more changes to get rid of some complexities. The system of radiological protection set out in ICRP Publication 60 evolved over 60 years. ICRP acknowledges that the current system

is complex and difficult to explain and consequently, is attempting to develop a new system that is more coherent and less confusing. The new controllable dose concept will be debated by the ICRP over the coming years.

Another major shift considered by ICRP is going from utilitarian to egalitarian ethics. The historic optimization process in radiation protection has been based on utilitarian ethics applying classical cost benefit analysis to address the question - "How much does it cost and how many lives are to be saved?" The use of collective dose emphasized the protection of society because of the difficulty in taking into account individual risk in any quantitative manner for the general public. A utilitarian ethic is the doctrine that the greatest good of the greatest number should be the guiding principle. In developing the recommendations for the 21st century, the shift continues from utilitarian values, so as to include the recognition of individual rights by using egalitarian ethics. Egalitarian is the principle of equal treatment for all individuals.

In summary, considering (a) the ICRP recommendations are still being debated and (b) the benefit to the general public and licensees is relatively low, there is, in my view, no pressing safety issue, to revise Part 20 to adopt ICRP-60 standards. We must, however, remain diligent to new concepts and be prepared to make whatever modifications to our regulations deemed worthwhile to meet our statutory responsibilities.

When and if the NRC decides on revising regulations, we will pay significant attention to the recommendations provided by the ICRP. But we must also consider insights from other scientific communities as well. There are other ongoing studies, such as BEIR VII, which will also be taken under consideration, before any rule changes are made. In September 1998, the National Research Council was awarded a 3-year grant to conduct a comprehensive reassessment of the health risk resulting from exposure to low levels of ionizing radiation. This reassessment (BEIR VII) will include a review of data that might affect the shape of the dose-response curve at low-doses, in particular, evidence for threshold in dose-response relationships and the influence of adaptive response and radiation hormesis on radiation exposure. In September 2000, the EPA requested a 2-year extension of the BEIR report and re analysis of the Japanese heath effects data. Assuming both reports are completed on schedule, the final BEIR VII report should be published in late 2003.

Conclusions

In closing, I would like to make two remarks, the first on my vision on the role of the Office of Research and the second, on my vision of ICRP and other ideas which it is currently considering on the near- and long-term impacts to NRC regulations.

My vision has not changed from last year. My vision of the NRC Office of Research would be a center of excellence and source of expertise. This center would maintain a cadre of reactor and materials safety specialists in various key areas, with independent and unbiased expertise across a broad spectrum of advanced nuclear technology, to provide the technical basis for robust and transparent regulatory decisions. Experimental facilities and resources would be maintained to ensure our ability to respond in a timely manner to new or emerging issues. The office would complement the front-line regulatory activities of the agency and independently examine evolving technology and anticipated issues. I would expect that we do more and focus on making what we produce more timely and more useful.

On ICRP recommendations and many other changes which are currently being considered by the Commission, I believe the following. In the near-term, although considerations of the ICRP-60 recommendations are still being debated, I believe that this is not a pressing safety issue in the US. It is premature to consider changes to 10 CFR Part 20, which would require use of recommendations of ICRP-60.

However, in the long-term, because ensuring public health and safety is as it should be our primary focus, ---and--- because through ICRP we receive the global benefits of the advancements in science and technology in the area of radiation protection, we should monitor and prepare to consider any new ICRP recommendations, -- after-- a careful evaluation of their merits to the society.

Thank you for your attention, I would be pleased to answer any questions you might have at this time.